Redefining Life Sciences through Innovation and Digitalization

Gathering Light on Enterprise Architecture In Practice, IT Modernization

and Innovation Use Cases

Redefining Life Sciences through Innovation and Digitalization

"Life Sciences" encompass companies in the fields of biotechnology, pharmaceuticals, biomedical technologies, life systems technologies, nutraceuticals, cosmeceuticals, food processing, environmental, biomedical devices, and organizations and institutions that devote the majority of their efforts in the various stages of research, development, technology transfer and commercialization.

(Fractal.org)

Market Outlook 2018

Market, Economics and Job Forecasts

Market Outlook : Global Life Sciences Market Outlook 2018

01

Expected to Reach $1.5 Trillion by 2022, Driven by Innovative Google, Amazon, Facebook, Apple (GAFA) Partnerships and R&D IT Investments

02

Global prescription drug sales are forecast to grow at an impressive annual compound rate of 6.5 percent in the next five years. Worldwide sales are expected to be US $1.06 trillion in 2022
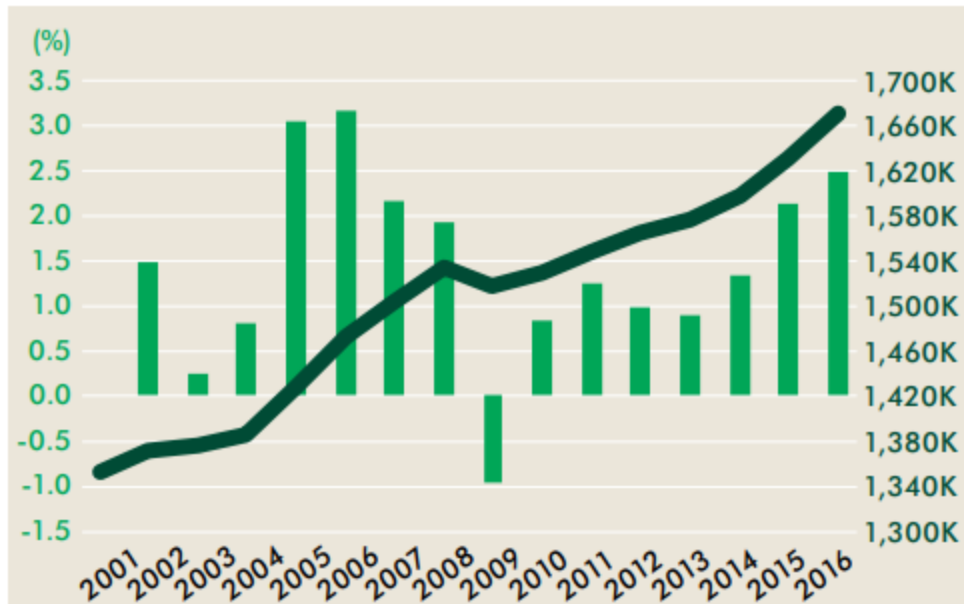
03

Global personalized medicine market is forecast to reach $2.4 trillion in 2022 at a CAGR of 11.8 percent, more than double the projected 5.2 percent annual growth for the overall health care sector

Growth will be driven by advancements in technology and targeted therapies that are more efficient and can provide more value

Research&Markets.com (Business Wire)

Market Outlook : US Outlook in Life Sciences

Employment Outlook

TOTAL U.S. LIFE SCIENCES EMPLOYMENT

COMPOSITION OF U.S. LIFE SCIENCES EMPLOYMENT
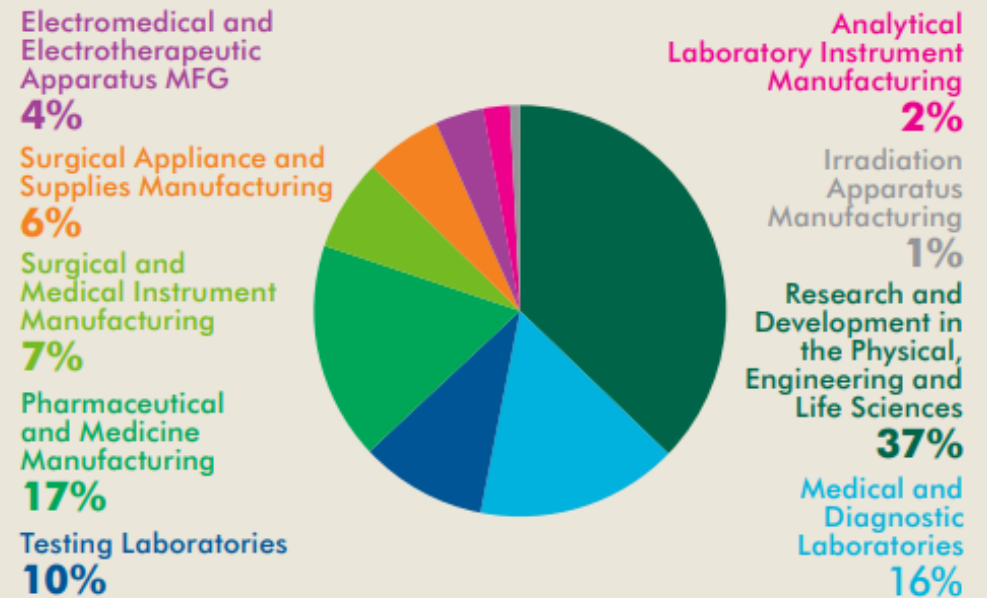
Electromedical and Electrotherapeutic Apparatus MFG
4%

Surgical Appliance and Supplies Manufacturing
6%

Surgical and Medical Instrument Manufacturing
7%

Pharmaceutical and Medicine Manufacturing
17%

Testing Laboratories
10%

Analytical Laboratory Instrument Manufacturing
2%

Irradiation Apparatus Manufacturing
1%

Research and Development in the Physical, Engineering and Life Sciences
37%

Medical and Diagnostic Laboratories
16%

US. BLS, CBRE Research Q3, 2017

Technology Modernization

Infrastructure, Strategy, Players, Architectures

Infrastructure : Modernization Considerations

01 — Due Diligence

02 — Business Impact

03 — Technology Impact

04 — Strategy Development

05 — Implementation Roadmap

Infrastructure : Strategy

Modernizing the existing IT environment is a powerful way to drive operational improvements and deliver cost savings. It is also a business imperative when facing organizational change or enabling new technologies and innovation

For example:

01 INFRASTRUCTURE MODERNIZATION

Prepare business case and modernization plan with strategy roadmap

02 CONSOLIDATION AND RATIONALIZATION

Streamline the existing hardware and operating system

03 MIGRATION PROCESS

Modernize systems, applications and data, and move to cloud with exceptions

04 RE-ENGINEERING PROCESS

Implement data center, people, process and technology changes

05 CLOUD DEVELOPMENT SERVICES

Design high-quality future state architectures and support

06 SERVICE MANAGEMENT

Aggregate service management, integrate and broker IT services, while managing and maintaining the environment

Infrastructure : 10 Largest Global Data Center Players

FIVE LARGEST WHOLESALE DATA CENTER PROVIDERS::

1. Digital Realty Trust: market share 20.5 percent, San Francisco, CA
2. Global Switch: market share 7.7 percent, Tai Seng, Singapore
3. DuPont Fabros Technology: market share 6.0 percent, Ashburn, VA
4. CyrusOne: market share 4.3 percent, Phoenix
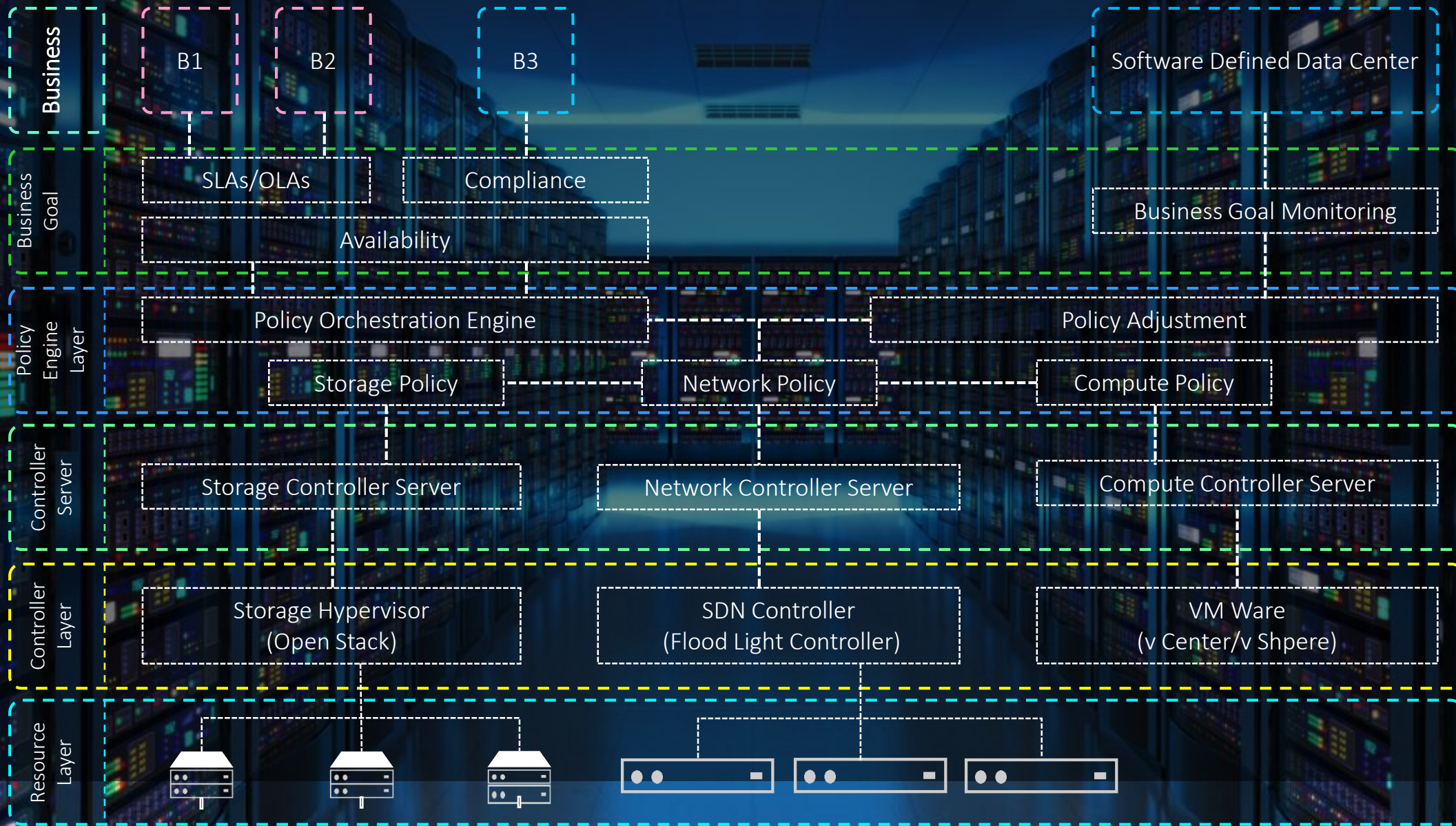5. China Telecom: market share 4.3 percent, China

FIVE LARGEST RETAIL COLOCATION DATA CENTER PROVIDERS:

1. Equinix: market share 10.5 percent
2. China Telecom: market share 5.9 percent
3. China Unicom: market share 4.3 percent
4. Telehouse (KDDI): market share 3.3 percent
5. NTT Communications: market share 2.1 percent

Infrastructure : Stakeholders

DOCTORS

DEVELOPERS

CONSUMERS

01

08 02

INVESTORS

07 Lorem Ipsum 03 INDIVIDUALS

04

06 05

HOSPITALS

RESEARCHERS

MORE

Conceptual Architecture : Software Defined Data Center

Business

B1   B2   B3   Software Defined Data Center

Business Goal

SLAs/OLAs   Compliance

Availability   Business Goal Monitoring

Policy Engine Layer

Policy Orchestration Engine   Policy Adjustment

Storage Policy   Network Policy   Compute Policy

Controller Server

Storage Controller Server   Network Controller Server   Compute Controller Server

Controller Layer

Storage Hypervisor
(Open Stack)   SDN Controller
(Flood Light Controller)   VM Ware
(v Center/v Shpere)

Resource Layer

Conceptual Architecture : Software Defined Storage

Other Considerations

Assets Management, ITSM, Security,
Big Data & Regulation

Management & Protection of IT Assets

01 Identification
- ✓ Technology Assessment
- ✓ Pre-Selection Framework
- ✓ Technology/Market Scanning
- ✓ Information Management

Selection **02**
- ✓ Technology forecasting
- ✓ Bench Marketing
- ✓ Decision Criteria & Process
- ✓ Monitoring/ Improvement

Protection

Identify Option

Establish Strategy

Monitor Effectiveness

04 Exploitation
- ✓ Customer-Supplier Network
- ✓ Incremental development
- ✓ Product management
- ✓ Complementary assets

Acquisition **03**
- ✓ Internal R&D/Innovation Lab
- ✓ Licensing & Joint Ventures
- ✓ Organizational Change
- ✓ Project Management

Source: Gregory

Integrated Service Management

IT Service Management

delivery model spans organization boundaries; especially in the federal space where service excellence is measured by how well and quickly one responds to internal customers to meet external mission mandate

Service Management

needs to be extensible, integrated and automated to support the business and respond to new technology advances

IT Service Management

- 01 CHANGE & RELEASE
- 02 SERVICE LEVELS (SLA, OLA)
- 03 ASSET MANAGEMENT
- 04 KNOWLEDGE MANAGEMENT
- 05 INCIDENT & PROBLEM
- 06 SELF SERVICE, MONITORING & AUTOMATION

Security

01

02

03

Bullet proof information security and cybersecurity strategy that spans the organization must be the laser focus

Broader security secure network architecture, encryption and data loss prevention (DLP) tools are few of the critical solutions for the layered protection required to secure high value data and assets

All of these must also be coupled with education and collaboration

Data (Big Data)

01

Data is the river that flow through the Infrastructure for neural networks

02

Deep learning, which is a subset of artificial intelligence (AI), is about enabling computers utilize raw data — similar to how neural supports the human mind

03

Deep learning requires extreme computing/compute, I/O, and networks, as well as exponential scaling

BIG DATA

Federal Regulation

01

Biotech, research laboratory, and medical device and pharmaceutical organizations most prepare and comply with new regulatory and policy mandates

02

Life sciences commercialization requires big investment for innovation, so failing to comply with changing regulation can have serious consequences, including fines, criminal prosecution and debarments

New Technologies

In Life Sciences

Blockchain

Market Outlook

Competitors - Top Players:

- ✓ IBM (US)
- ✓ Microsoft (US)
- ✓ Guardtime (Estonia)
- ✓ PokitDok (US)
- ✓ Gem (US)
- ✓ Chronicled (US)
- ✓ iSolve (US)
- ✓ Hashed Health (US)

- ✓ Patientory (US)
- ✓ Factom (US)
- ✓ Proof.Work (UK)
- ✓ SimplyVital Health (US)
- ✓ FarmaTrust (UK)
- ✓ Blockpharma (France)
- ✓ Medicalchain (UK)

Around 14% of healthcare organizations are expected to have a blockchain based system in place by the end of 2018, while 70% are expected to have invested by 2020

Blockchain could save the healthcare industry up to $100-$150 billion per year by 2025 in data breach-related costs, IT costs, counterfeit products and other technology related costs

Most prominent beneficiaries of the technology will be the pharmaceutical companies, which lose approximately $200 billion to counterfeit drugs each year

Use of blockchain for healthcare data exchange will contribute the largest market share to the blockchain in the healthcare market throughout the forecast period, reaching a value of $1.89 billion by 2025.

Use Cases Innovation and Digitalization

Market Outlook

Competitors- Top Players

- ✓ Welltok, Inc.
- ✓ Intel Corporation
- ✓ Nvidia Corporation
- ✓ Google Inc.
- ✓ IBM Corporation

- ✓ Microsoft Corporation
- ✓ General Vision, Inc.
- ✓ Enlitic, Inc.
- ✓ Next IT Corporation
- ✓ iCarbonX

- Global AI in healthcare market was valued at $1,441 million in 2016, and is estimated to reach at $22,790 million by 2023, registering a CAGR of 48.7% from 2017 to 2023

- Healthcare artificial intelligence market from the medical imaging and diagnosis application is projected to exceed a revenue generation of USD 2.5 billion by 2024

- Drug discovery application held 35% of the overall market share and is expected to attain gains at 40% over 2017-2024, collecting revenue worth USD 4 billion by 2024

- Established players such as IBM, Microsoft, Cyrcadia Health, and Google are investing heavily to unleash the potential of healthcare artificial intelligence industry. As per the estimates, the market is slated to exceed a valuation of USD 10 billion by 2024

Deep Learning

Market Outlook

Competitors - Top Players:

- ✓ IBM (US)
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Growing adoption of deep-learning technology will help fuel the global market at an estimated compound annual growth rate of 53% or more through 2020, with the single largest push coming from the life sciences and healthcare space. That's an estimated $968 billion [in 2021 value] worth of potential incremental growth

The healthcare segment is anticipated to grow at a significant rate of over 55%, as the technology is outspreading the translational bioinformatics, medical imaging, and sensor-driven analysis

In 2016, the healthcare sector accounted for the highest revenue share of the global AI market, about 15%

Use Cases

Technologies Advancing Life Sciences For Good

FOOD TECHNOLOGY - CRISPR

Competitors – Top Players

CrisprTherapeutics (CRSP, IntelliaTherapeutics (NTLA) and EditasMedicine (EDIT)

Benefits

Using CRISPR to add—or remove—a plant trait is faster, more precise, easier, and in most cases cheaper than either traditional breeding techniques or older genetic engineering methods and altering specific genes can create curative medicines.

Growth Opportunities

The BLS has reported that biomedical engineers can expect to see a 23% growth in demand for years between 2014 and 2024, which is one of the fasted rates.

Source: Bureau of Labor Statistics (BLS)
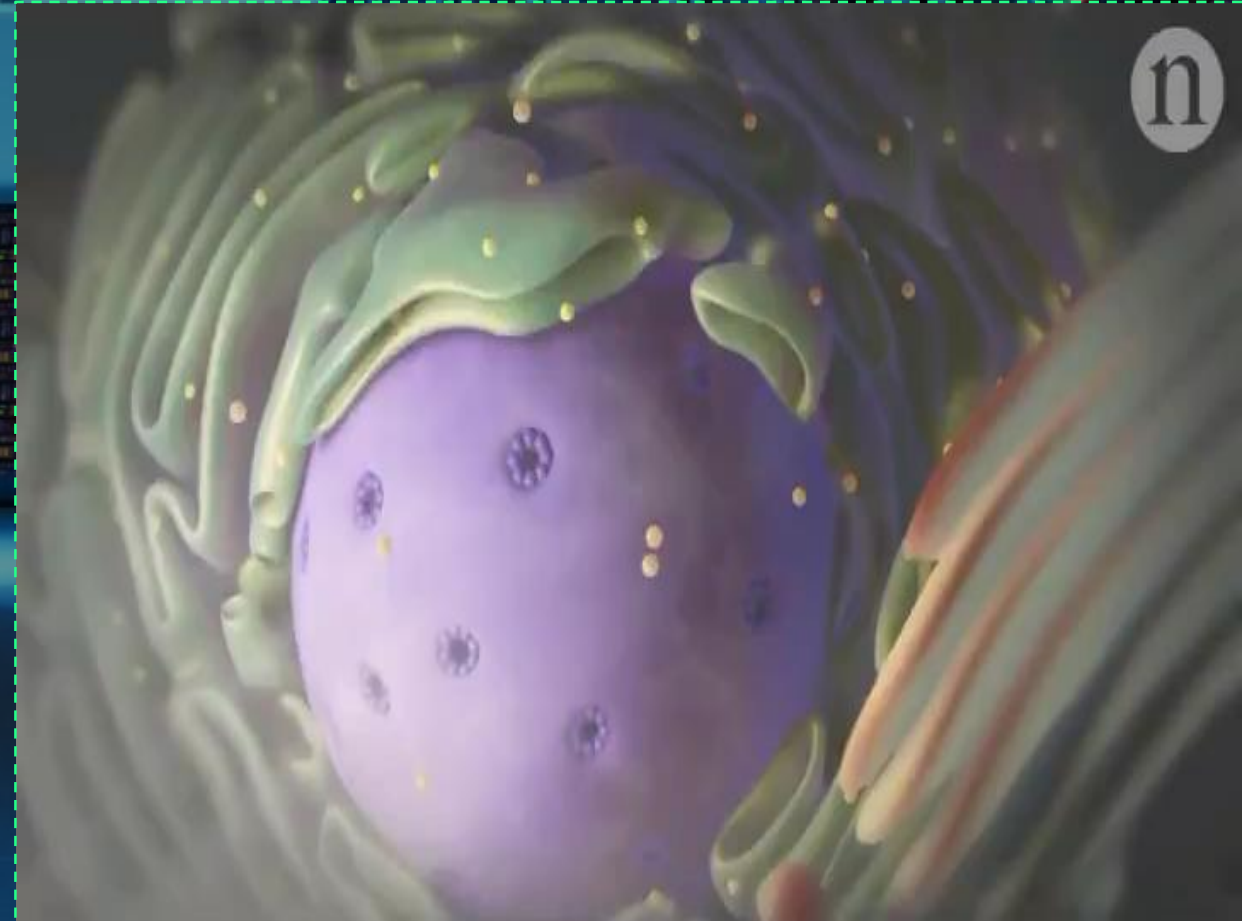
Skin Technology Detecting Health Status

Competitors

The key players operating in the electronic skin market include MC10, Xensio, Rotex Inc. Intelesens ltd, Immageryworks Pty Ltd, Dialog Devices Limited, SmartLifeinc Limited, Xenoma Inc., Plastic electronic GmbH, and VivaLnK, Inc.

Benefits

The growth of the electronic skin market is driven by surge in demand for superior & periodic health monitoring systems, rise in expenditure on advanced wearable devices, and increase in investment on robotics technology.

Growth Opportunities

Global electronic market is expected to reach $1,719.38 million by 2025. Growing at a CAGR of 38.7% (2021-2025

Source: Allied Market Research & IBD

Augmented and Virtual Reality in Surgery

Competitors – Top Players

Microsoft Corporation (US), Google Inc. (US), Vuzix Corporation (US), Blippar Inc. (UK), Metaio Gmbh (Germany), Oculus VR, LLC (US), EON Reality, Inc. (US) and Qualcomm Incorporated (US)

Benefits

Virtual reality used in operating rooms, surgical sites, for patient anatomy and for therapeutic simulation, gaming

Growth Opportunities

Virtual Reality (VR) Market to Grow at 57% CAGR with $45 Billion by 2027
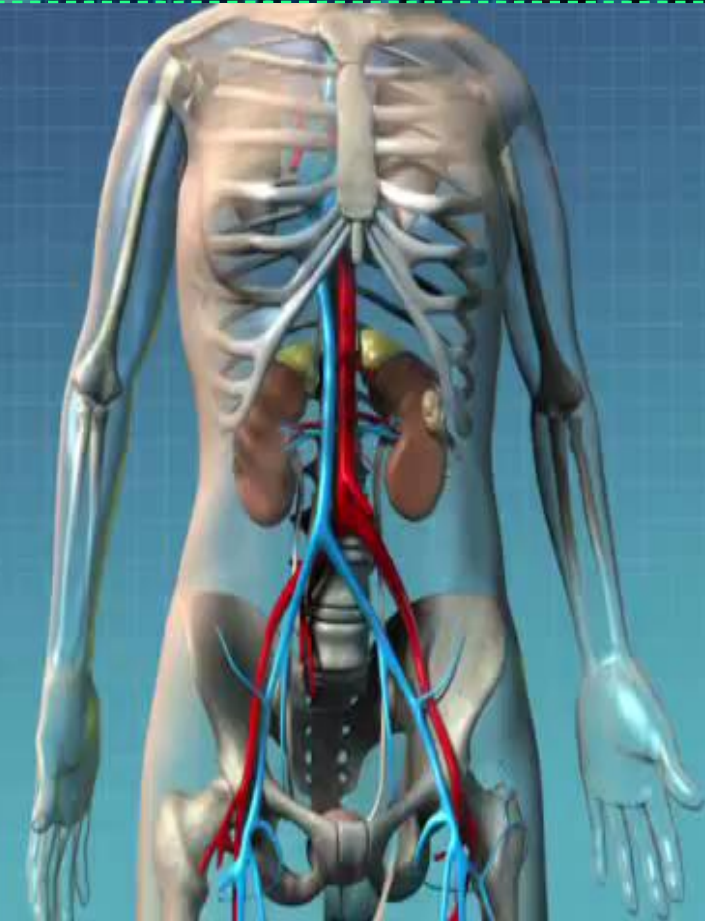
Source: Reuters

Deliverability: Framework, Tools & Workforce

Essential Skills & Tools for Creating Stakeholders' Value

Value Based Enterprise Architecture

When implementing Enterprise Architecture as a program or initiative, it is regularly IT centric and rarely considers what the costs will be and if there will be any return on investment

- ✓ Keep up with latest industry trends
- ✓ Understand Statistical analysis and financial valuation
- ✓ Have Knowledge of portfolio and program management
- ✓ Interpret requirements from stakeholders' perspective
- ✓ Build subject matter expertise in specific areas
- ✓ Process emotional intelligence and common sense
- ✓ Must be politically savvy and culturally mature
- ✓ Understand critical marriage between design thinking and innovation

1

2

3

4
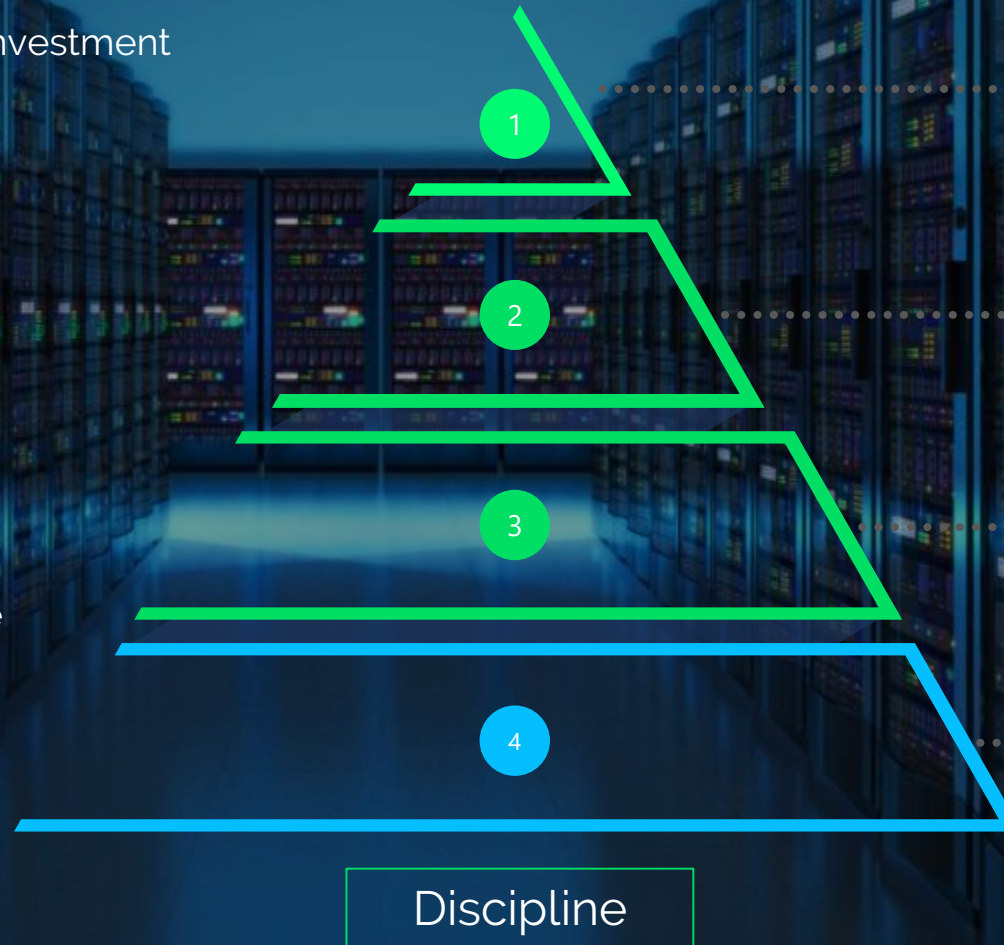
Public Trust, Safety and Security

Architecture Management, Risk Management, Resource Management, Investment Oversight, Transformation, Technology Vision

Practice Duties

Alignment, Models, Learning, Strategic, Measures, Influence, Fiduciary, Governance
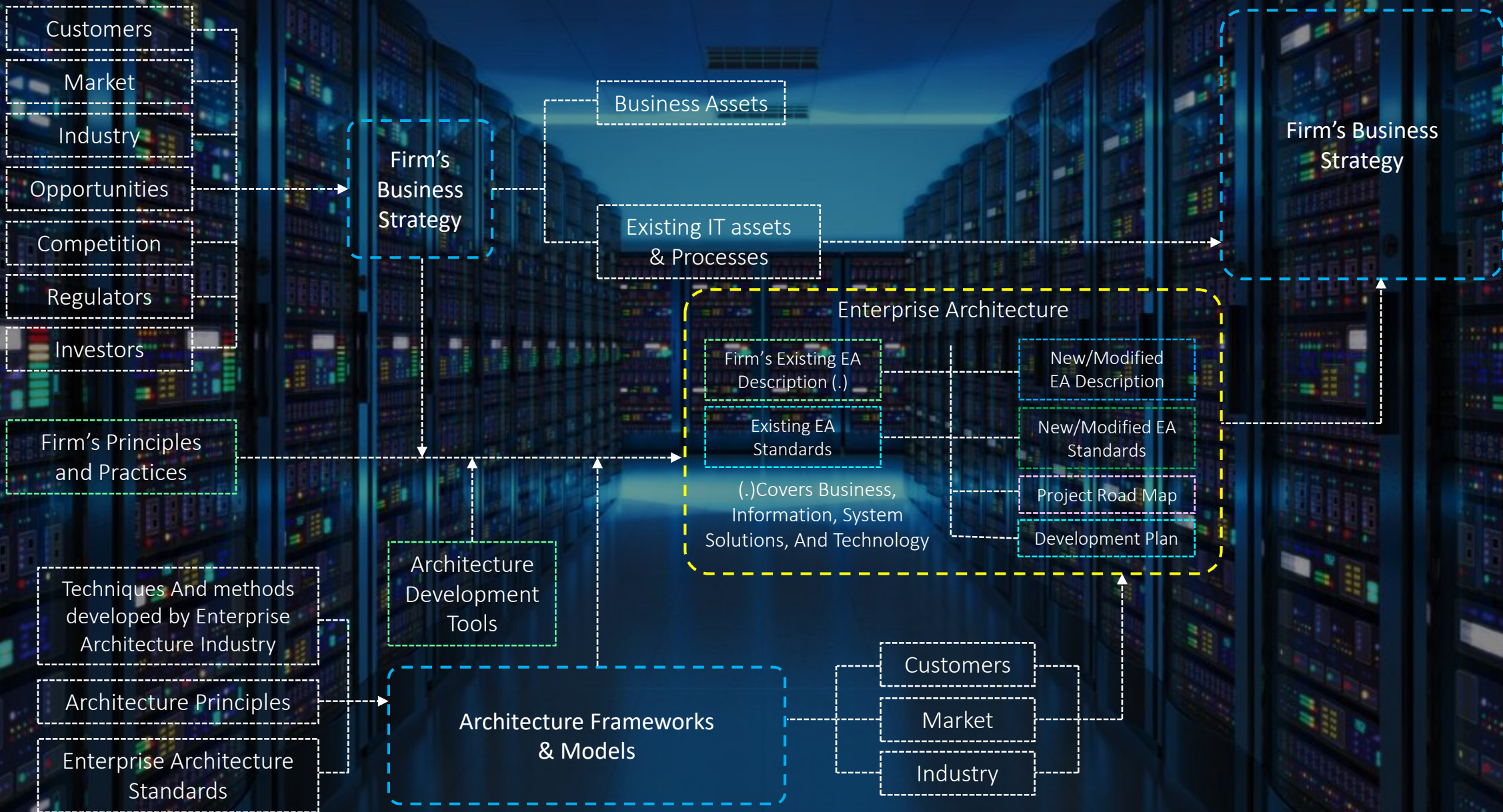
Practice Standards

Examinations, Experience, Education, Ethics

Standard of the Profession

Body of the knowledge, Professional Education, Industry Governance, Branding, Code of Ethics, Accreditation, Professional Development, Skill Development.

Discipline

Conceptual Architecture

Digital Workforce

01

New algorithms, automation, machine learning and digital platforms is radically changing the talent pool dynamics

02

Recent US Presidential new ' Cloud Smart' mandate puts Workforce Modernization as 1 or 3 key points

03

Question is not when but how and what organizations will do now, to ensure a proper digital workforce for now and readiness for future innovation in life sciences

Industry Best Practice Tools

Summary

Takeways

The Presenter

Ellen Crayton is a strategic leader and subject matter expert on IT Modernization, Cloud and Innovation with over 25 years of enterprise-level consulting experience in the life and health sciences, financial, and retail sectors. She has led enterprise level IT strategic initiatives for the public and private sectors covering health care, finance and ecommerce for clients at the Gauteng Shared Service Centre (GSSC) in Johannesburg, South Africa, Dow Jones Markets, New York, Ernst & Young, New York, NYNEX Meridian Systems, New York, the City of New York Office of the Mayor and currently, key member of the Precise Software strategic team that provides C – Level IT advisory for a federal agency in Mid Atlantic area.

Prior to consulting, she held senior positions in both the private and public sectors, including positions with Ernst and Young, LLC; Dow Jones Markets, Inc.; Nortel (Meridian); the International Trade Center in Geneva, Switzerland; and Gauteng Shared Services Centre in Johannesburg, South Africa.

She is at the forefront of research in value-based enterprise technologies, cloud infrastructure, service automation and innovation. Having lived abroad and traveled extensively, Ellen has a strong understanding of IT and management strategies in various markets throughout North America, Europe, and Africa.

Ms. Crayton earned her Master of Business Administration (MBA) degree from Case Western Reserve University's Weatherhead School of Management in Cleveland, OH, and a Bachelor of Science (BS) degree in Management Science from Saint Francis College in New York, NY.

Ellen Crayton, MBA
Certified: ITIL v3, TOGAF

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Notables Quotables

"Creativity is intelligence having fun."
"I have no special talents. I am only passionately curious."
"A person who never made a mistake never tried anything new."
"The difference between genius and stupidity is, genius has its limits."

Albert Einstein

" The art challenges the technology, and the technology inspires the art. "

John Lasseter (Director)

"I do not think there is any thrill that can go through the human heart like that felt

by the inventor as he sees some creation of the brain unfolding to success."

Nikola Tesla

Let's stay in touch

Thank you!

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